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THE

MERITS OF THE ASSOCIATION FOR EMPLOYING  
AN AGRICULTURAL CHEMIST,

ILLUSTRATED IN

A LETTER  
TO THE LANDED INTEREST OF SCOTLAND.

BY

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SECOND EDITION.

EDINBURGH:

MACLACHLAN, STEWART, & CO.

MDCCCXLIII.

THE design of the following pages is to illustrate the importance of an Association which has been established in this country for the employment of an Agricultural Chemist. The writer has little experience in Agriculture, and would gladly have seen the subject engage another pen,—but, lest a good cause should suffer from want of support, he willingly devotes to it the fruits of some rather desultory reading. He has no object to serve,—none but the general good.

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*After a small impression of this Letter was printed and distributed, the Committee of Management of the Association expressed something like a wish for five hundred copies to circulate through the country. In return for this compliment, the writer thought he could do no less than give them a few additional pages, which accounts in part for this being a second edition.*

*Since these few pages went to press, the writer has learnt, with much satisfaction, that the farmers around Turriff, before the present scheme was agitated, were thinking of having a Chemist for themselves by subscription. It does them infinite credit.*



## THE MERITS, &c.

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THE project of employing an Agricultural Chemist is one so new, and which has come upon the proprietors and tenants of this country so suddenly, that it is not to be wondered at if it should require to be explained and illustrated. The agricultural interest, in common with the commercial and the manufacturing, is at present in so depressed a condition, that anything which offers relief merits attention.

But independently of this ephemeral, and it is to be hoped passing interest, the project in itself has a great deal at any time to recommend it ; and it would be a reflection, we think, on our country if, in these enlightened days, it should be allowed to languish, much less to die away. But we hope better things for it, being satisfied that if it be only understood, it cannot fail of success.

The general design of the Association may be briefly stated to be this. A Chemist of highest eminence, and not unacquainted with agriculture, is to be engaged ; and during the winter months he will devote himself to analyzing soils, manures, and other matters sent him for analysis by members of the Association. In summer, again, he will visit, at the request of Subscribers, different districts of the country, and give information as to the kinds of manures best suited to the various soils, explain the action of drainage, irrigation, and subsoil-ploughing, and generally contribute, either in the form of private advice or by giving a few lectures in the neighbouring town, to the improvement of the district.

In the choice of the Chemist, there will of course be exercised the greatest care and impartiality. One who has studied in the school of Liebig, or one at least, who, by his knowledge of the German language, has made the science of Liebig his own, will probably be preferred ; and, with regard to the



charges\* to be made for analyses, all that can be said is, that they will be so moderate as to encourage farmers, seedsmen, &c. to resort to him ; at the same time, that they will not be so low as to inundate the Chemist with wanton and foolish applications, to the engrossing of his time by some, whilst others cannot be attended to. If the subscriptions amount to a handsome sum, and they be promised for five years, then a first-rate chemist may be tempted to quit his present occupations, whatever they may be, to settle here, and he will not require to look to the analyses as a source of profit. But if, on the other hand, they be scanty, a man of less note must fill the place, and the analyses must eke out his small and precarious income. It is the interest then of all, and particularly of those practical men who will want the Chemist's aid, that the contributions of such as have no views of the kind for themselves, but give merely out of their liberality, from love to science or their country, should subscribe worthily. Most gladly would the Association yield to a wish which has been often expressed to them, that analyses should be charged at a low rate ; but this cannot be, unless the subscribed fund be pretty large, and even then there will be a risk, which must somehow be provided against, of the Chemist and his assistants, if he has any, being sadly overtasked. If, however, any person thinks that the plan of operations, as sketched out by the Association, is not so good as one he has been considering, with all deference the proper inference he should draw is, not that he is thereby excused from supporting it, unless he thinks also that it would be better to have no association at all than the present, but simply that the committee and he differ about the details. His choice lies between this Association, with all its faults, and none ; and analysis, it must be remembered, is, after all, but one of the many contemplated benefits.

But to proceed,—it is difficult to say whether the analyses of the winter hours, or the summer progresses of the

\* The public may be curious to know what is the cost of analyses. Now this depends on circumstances. If a very accurate and full analysis be wanted, the process is a delicate and tedious one. But in most cases a simpler one will suffice, and answer all the ends of the party getting it, which will save expense and spare the time of the Chemist for others.

Chemist, will be most useful. Does a farmer think of buying a cargo of guano, or bone-dust? he may have it analyzed, and its purity and value ascertained. Or has he a suspicion that there is lime or marl on his land? he may have the information from the Chemist. Or can he get soot in quantities? Or are there substances cast off and thrown away at some neighbouring manufactory, a gunpowder-mill, for example, or a gas-work, or soap-work? he may send in a sample for analysis, and perhaps discover that what was thrown away as useless, is really of much value. An instance of this kind occurred very lately, and in this very neighbourhood; and as a single fact with some men outweighs a thousand theories, it may be right to mention it here. At the Roslin Gunpowder-mills, then, there was a refuse heap thrown aside by the proprietor of them, to which, for many years, the public, or any man who had a cart, was made welcome. In time, it was observed by some neighbouring farmers, that the grass grew luxuriantly around and near it; and among them such competition for it sprung up, that the proprietor of the mills would not part with it under £1 a ton. But the price soon rose, and in a few years at last it reached L.12 a ton; and it is but the other day that the person, Mr Finnie of Swanstone, who bought it last season for that sum, on offering the same again this year, was answered that the proprietor of the mills had taken a leaf out of the Association's Book, and had had the refuse analyzed, the result of which was, that it was worth L.14 to himself for putting once more through the mills, and so was no longer to be sold to any one. Any Chemist could have predicted, that as the nitrates, from their yielding nitrogen, favour vegetation, the refuse must be useful; and thus, what in this instance was the result of an accidental discovery at first, and of some years' experience afterwards, might have been known much sooner. The account in Mr Bakewell's *Geology*\* of the Miners in Derbyshire, who for centuries, and indeed from the time of Hadrian down to the year 1803, threw away a valuable ore of lead, mistaking it for heavy-spar (sulphate of barytes) until a chemist undeceived them, reads us another instructive

\* P. 428 of 4th Edition.



lesson of the same class ; and we could multiply instances of the kind, if there were any occasion. Very lately, Mr Lawson of this City, had two cargoes of oil-cake tested by a Chemist, and the result was most satisfactory ; and when one reflects on the extent to which oil-cake and other such substances, equally capable of adulteration, are now imported from all quarters, the value of chemical aids really cannot be over-rated.

One word more on this subject. It is not that tenants will delay purchasing guano, or artificial manures, of which at present there is no lack, until they have the results of an analysis to guide them, for sometimes the seller's offer will admit of no delay. But the knowledge and dread of such an ordeal will operate to deter dealers from adulterating what they have to sell ; and this will be a benefit, not merely to members of the Association but to the whole community. Frauds will be scared away by the mere risk of exposure.

We have had occasion to name guano more than once already. It is a substance comparatively new in this country, and costly, and there is some risk, that before long, its exportation from the shores of the Continent of South America will be prevented. Its fertilizing effects have been long known and appreciated in that country, and the preservation of the flocks of wild-fowl that yield it, has ever been most anxiously and rigorously guarded. In the turmoils of civil dissension it has been allowed to escape to us ; but this cannot last, and the chemist's aid must, for us, ere long replace it artificially. Already experiments are in progress on this subject, and a substitute suggested which costs only L.2, 1s. a-ton ; and we allude to it merely to shew how varied and inexhaustible the services are which science may render to agriculture. But we may briefly recount some others.

Drainage is a subject on which much light may be thrown by the Chemist in his summer lectures. We all know what it has done for this county within the last few years, by ameliorating the climate, and increasing, probably to the extent of one-sixth, the general productiveness of our land. Most men understand, in a general way, that it amends the climate, yet how few know that it does so by lessening the extent of the

surface from which evaporation proceeds, and by a chemical action, also, inasmuch as water has a predilection for certain of the ingredients of the air above the others.

Even more men, however, take false views of the action of drainage on soils, and are at a loss to reconcile the propriety of it with the benefits of irrigation. If removing water, they naturally say, is to operate well, then flooding must be an evil. It is but adding tears to the “needless stream,” where all is in excess already. But drainage acts in part,\* by admitting fresh supplies of water to the soil, and with it fresh supplies of air,—and in this respect irrigation and drainage operate alike; whereas, the water that stagnates in undrained land has no fresh supplies of water or of air to offer to the roots of the plants or the elements of the soil. All this and much more might be popularly, and in an interesting way, made intelligible to the farmers of our country.

The same may be said of the rotation of crops. How comes it that in some countries certain soils will yield the same crops for very many years in succession, whilst in others the produce will diminish annually, and at last cease entirely? The excretory theory of plants, their tendency to throw off at the roots what they reject or have polluted as useless to themselves and *so to plants of the same species*, and their having used up all of certain elements in the soil, though they have left other elements that suit other plants which may therefore enter into the rotation—these two facts offer an intelligible and very interesting explanation. People talk of the land being *exhausted*, but the phrase is a mere cloak for ignorance. Land, dead and inert as it is, admits of no exhaustion or weariness. Robbed it may have been of some one element (phosphate of lime, perhaps, for example) by the crops raised having been year after year carried off the ground, till at length there actually remains no more of that element in the land, and another crop would starve and pine for want of it. And polluted the land may have become by matter thrown off from the roots of the crop which has been so injudiciously repeated, till the same species of plant can no longer live in it. But

\* See Johnston's Lectures, p. 442.



this is all that is known or can be said of what is called exhaustion ; yet it is some advance to a knowledge of its cause, and may suggest the proper remedies.

Again, there is an idea that vegetable mould is all that is needful in a field ; yet there are soils barren though they contain 11 per cent. of vegetable matter, and other soils fertile with only half a per cent. of it.\* But these things too may be explained, and so may the action of fallows and of fallow crops. And it is not indulging an idle hope to say, that in time it may be discovered what element has been abstracted from our carse lands which has disabled them for bearing such crops of wheat as formerly. We know that the air and the rain that nourish them are the same now that they ever were ; and so we are driven to the conclusion that it is in the soil that the change has been effected, and possibly chemistry may discover and restore the element which has been withdrawn. In a national point of view this would be an important thing, and our Chemist would require to be an able analyst. It is of late years only, indeed, that such an enquiry could be thought of, for even in the hands of Sir H. Davy the phosphates and potash too often escaped all notice.

The point to which fermentation or decomposition should be carried in manures is one on which practical men differ, and that most widely, and it is one other subject on which the minds of the farming community might be enlightened by the Chemist. Indeed, we could add almost interminably to the catalogue of things to be explained. We might allude to the process of germination, and shew, that if the farmer knew whether light or darkness most favours the springing of the seed, and understood how the air acts, he would then know whether he ought to sow in bright weather, or when it is cloudy, and how deep he should cover in the seed. But we hasten to notice what we regard as more important, and briefly of course, for we can bestow little more than a passing remark on any of these interesting topics. We allude to the peculiar fitness of certain compounds for certain

\* See Johnston's Lectures, p. 415 and 419.



soils; and fortunately sufficient progress has already been made in this field of observation, under the eye of Mr Fleming of Barochan, Mr Burnet of Gadgirth, Lord Blantyre, and others, to give an earnest, at least, of what may be done in it. Already there has been, we might almost venture to say established, the peculiar adaptation of bone-dust, and indeed of all phosphates, to peat soils,—of sulphate of soda, and of the alkalies generally, to trap districts, where the augite and hornblende yield enough of lime,—and of marl and limestone to granitic soils, for these are already supplied abundantly with potash and the silicate of alumina. Probably, but the Chemist could tell us (which is one instance of his being wanted), the highlands might send down decayed granite to the low country, and get back mouldering whinstone, with great advantage to both the districts.

How much, then, has science done for these things, and how interesting to any man of ordinary mind to know about them! Yet much remains to be discovered; and far from that consideration being discouraging, we look on the untrodden paths that lead into the unexplored wastes and the secluded haunts of the science, as so much the more interesting; and it will be not the least important of the Chemist's numerous duties, that he will have to guide the steps of any who are willing with him to explore them.

In plain language, he will suggest experiments; and made, as these must be, in different parts of the country, they will have an obvious advantage over any which he could institute himself in an experimental garden, with little diversity of soil and none of climate. So confident of the benefits of such inquiries are the more enlightened among us, that a large proprietor in Forfarshire has handsomely offered, if the present scheme succeeds, to place a portion of his estate at the disposal of the Association for experimenting. The materials to be tried as manures, being first of all subjected themselves to analysis,—the land on which they are found to fail or to succeed, being next analyzed,—general conclusions will be arrived at: And these general results, again, being next made the groundwork of other trials, it is difficult to affix any limit to the progress of the science.

Now these last views will be relished or disliked according

to the mind of the reader. To some they will be fraught with much interest, and for such we could with much pleasure to ourselves enlarge a little more on the discoveries that may reward them. We could shew how that, collaterally, inquiries may throw light on other arts and processes, which have to all appearance little alliance with them. At present, for example, premiums\* are being offered abroad for manufacturing fermented liquors, and beer, in particular, so as to rival that made in Bavaria for strength and resisting acidity; and here, experiments in fermentation might turn to good account. Again, the conversion of starch into cane sugar would make the fortune of any one; but whether lime used *in vacuo* to abstract the excess of its oxygen and hydrogen from grape sugar, or the offer of some disposing affinity to them, or the use of galvanism, would avail, or what the process may be, is not for us to say; but the idea and its prosecution would most naturally occur to a person engaged in studying the changes which the sap undergoes. Surely it is not more unlikely that starch may in time be changed into sugar by some chemical process, than that potatoes should have been made into small beer and brandy, as is now done in great quantities in France, or that Becquerel† should have succeeded in forming some of the gems artificially, or that the processes of digestion and of the rise of the sap in plants, and the secret of nature's art in filling mineral veins, should have become the tricks and toys of our laboratories, as they now are one and all of them. ‡

But these are curious things, for the young and the inquiring, rather than useful, and perhaps they are out of place here, for we are quite aware that we have somehow got across the march, and are fairly trespassing in the proper domains of chemistry. We have no wish to puzzle plain practical men with such things. They have their callings to mind; and the honest farmer that whistles at the plough, and his master, would be ill exchanged for the dreamy philosopher, or the

\* Liebig's Chemistry in its application to Agriculture, p. 332.

† See Somerville's Connection of the Sciences, p. 307, first edition; and Buckland's Bridgewater Treatise, i. 598.

‡ For those who feel interested, we may refer to Holland's Medical Notes, p. 621; Johnston's Lectures, p. 125; and Phillips' Geology, ii. p. 161.



“starved apothecary” of the play. But some men, with no bad intention, may hang back, and will not submit to be tutored by the Chemist, or to map out one of their fields into square spaces of a quarter of an acre for experimenting. They will have no glauber salts among their potatoes, and there is no help for it. In this free country, indeed, a man cannot be compelled to take phosphates and sulphates on their trials. And other men will say, “we are no chemists, but plain men, and are quite at sea when we get among acids and alkalies.” Now, fortunately, there are considerations which may have some weight with all such persons, and with these we shall close our remarks.

*First*, then, it is a great mistake to imagine that any science will be required of the farmer. If he will only do what he is directed to do, taking so many bushels of gypsum or guano from the chemist, and laying it on so much land, and weigh the produce, then his part is done, and done well. It will rest not with him, but with the chemist, to draw the inferences, after having laid the groundwork for them in an analysis of the soil, of the manure used, and of the produce. The chemist, in short, will preside, the master-spirit, and the others will run to do him service.

*Next*, in these days of zeal and advancing knowledge, any man that stands still will be sure to be passed by his neighbours. Whoever possesses superior intelligence will be enabled to raise larger crops and at a lower cost than others, and knowledge will have its reward. No doubt, the times are bad, and out of joint for farmers and every body else. Jack Cade’s hopes, that “there should be in England seven halfpenny loaves sold for a penny,” are too near being realized. Still, be the prices ever so low, or, rather, just because they are so low, there is the more need of exertion, and the man that can raise good crops more cheaply than his neighbours will have an obvious advantage; so, if guano or gypsum are to give him that superiority, the sooner he makes their acquaintance through the chemist the better.\*

\* The instances that might be given of benefits derived by farmers from chemistry, are so numerous, that we are at a loss to select. The writings of Daubeny and Johnston, and the papers of the Highland Society, are full

But *lastly*, and *above all*, the pleasures of an enlightened pursuit will be substituted for the blind drudgery of following methods and practices without the slightest exercise of reason. How often is liming repeated, when lime can be of no farther avail? The loss, the pecuniary loss, is easily understood, for it is soon felt; but there is another loss, in the blindness and ignorance that unfit the individual for reasoning at all about its cause. He wants, in short, both his money and his pleasure.

Now, whenever principles take the place of mere practice in the mind, the powers of observation are awakened and excited. The individual is not merely “in the way of good luck,” as Lord Brougham terms it,\* but he is on the look-out for it, and so nothing escapes his notice. Newton accounted for his great discoveries in no other way than by saying he was “always thinking about them;” and Professor Hunter, the celebrated physician, owed his eminence to the same cause.

But we must enlarge a little. Practice has unfortunately been too uniformly contrasted in popular language with Theory,—as light is with darkness and heat with cold. The cases, however, have truly no analogy; for practice may be based on theory, and then, far from being opposed, they are the best of allies. Theory or principle, or under whatever name it goes, is at first but an *idea*, impelling men to make trials and compare results. One author† likens it to a bridge thrown over the void to connect separate facts: another (Professor Whewell), to a chain that binds together what is loose and

of them. From our limited space, one case must suffice. A tenant of Sir George Clerk, Mr M’Lean, has a farm in a high upland district, between 800 and 900 feet above the sea. Much of his land is of the poorest description, but he took some hints from Mr Johnston’s lectures, and with what chemistry he could command commenced improving. The results rewarded him most amply for all his trouble. From land not worth above 25s. or 30s. the acre, his profits were from L.2 to L.5 per acre. Yet this was the case of a farmer, in the infancy, it may be said, of this science, with little knowledge of his own, and unable as yet, unfortunately, to get more any where. What would he have done if such subjects had been better known than they are, and how much money would he have been spared if he had not been obliged to make trials for himself? His paper, with all the details, is in the archives of the Highland Society.

\* Objects of Science, p. 36.

† Dr Adam Smith in his Essays.



unconnected in nature. In any view, without theory, facts would not be recorded or noticed, or turned to account, and it is the parent of all discovery. But theory not merely discovers, it embalms and preserves also. What it gleans in the fields of Nature it garners up most faithfully ; and thus it is that processes in the arts, which, but for the principle that embalms them, would be lost, are preserved to distant ages.

What accordingly has been the fate of arts whose principles have been neglected or never been known ? They have first declined and next disappeared, and history records unfortunately but too many examples of such. Where, for example, shall we find preserved for our instruction the secret process by which the ancients were able to render iron proof against the action of the weather, though Pliny\* assures us there was a bridge across the Euphrates possessed of that character, and though the fretted iron-work around the tombs of the Scaligers at Verona has been thought by some to have had it also ? † And what was the art of making glass malleable that we read of ? Or how did the Greeks arrange‡ the Echeian chambers of their theatres, so that the minutest whisper could be heard ; or the Egyptians§ move masses of rock above 800 tons in weight across 140 miles of desert country ? Or what was the art by which the Moors|| preserved paintings and wood work for ten centuries in the lordly piles of Granada ; or that by which the Egyptians of old wove their delicate webs of “ fine linen,” which have distanced even the renowned fabrics of Dacca ? These are things that we read of with wonder, and lament ; and there cannot be a doubt that if they had not been left to pass down from hand to hand as mere arts and processes, till at length the last copy had little semblance of the original, but had been embalmed for us in something like a principle, they would not so utterly have perished as they have done. Other inventions, better fated, might be mentioned, which, after suffering something of an eclipse, have reappeared in

\* Thomson's History of Chemistry, p. 66.

† Stewart Rose's Letters from Italy.

‡ Pompeii, ii. 233.

§ Wilkinson's Ancient Egyptians, iii. 330.

|| Murphy's Mahometan Empire in Spain, p. 284-5, and 196.

our days ; such as the use of the magnet, which some persons\* have thought they could trace even back to the days of the Phœnicians ; and the use of mordants in dyeing, which, there cannot be a doubt, the Egyptians of old possessed. But enough has been said to shew that mere *processes* have a principle of decay in them, but Science one of enduring progression.

It has been the dread of an enlightened foreigner,† that the passion for acquiring wealth by speedy arts might be fatal in America to the progress of science, and that the result would be, that both would find too soon a common grave. We should regret to have thus verified among us the remark of Lord Bacon, that when there is “ a peremptory reduction of knowledge *into arts and methods*, from that time commonly sciences receive small or no augmentation.” Yet we confess we know nothing to exempt Agriculture in this country from the risks of decay, if, instead of aspiring to a science, it is content to grovel a mere art. If handicraft processes, as we have shewn, will decline and at last be lost, surely agriculture, which is no handicraft art, but requires judgment and observation, cannot safely bid away from it the proffered aids of science. It may not be lost, indeed, in one sense, as long as the art of printing lasts ; but it may linger on in blind observances,—liming every year, often injudiciously,—using traditional systems of rotation with no discrimination,—trying irrigation without drainage,—expending manures on soils which a Chemist could predict they cannot suit,—paying absurd prices‡ for them,—and wasting salt on land within the influence of the sea breezes. Surely all this would be unworthy of the age, and no credit either to our tenantry or their landlords ; it would be a stigma on us, in the eye of enlightened Germany, with its institutions and schools for agri-

\* Sir William Betham’s *Etruria-Celtica*, vol. ii.

† De Tocqueville, iii. 90.

‡ As an instance, Dr Madden analysed three cargoes of nitrate of soda, all selling at the same price of 25s. per cwt., and he found one of them to contain 14 per cent. of impurities, and another actually 26 per cent. The salt-petre (nitrate of potash), sold at the India House, is previously analysed, and an abatement in the price made for impurities.—Prize Essays of the Highland Society, vol. xiv.



culture, and, indeed, of all Europe ; and a blot, in short, on the fair escutcheon of old Scotland.

One word ere the reader of these remarks and the writer part. He has thrown them together hastily, to be in time for certain meetings among the farmers ; being ardently impressed with the importance of the Association, and most anxious to give it what assistance he can. It is no visionary scheme of a Chemist, but, on the contrary, it originated with Farmers in Midlothian. And will farmers elsewhere be behind ? Or will lairds be behind the farmers ? The thing is impossible. We cannot suppose that any will indulge the selfish short-sighted idea, that because they live perhaps at a greater distance than some others from the Capital, they will have less benefit from the Chemist's labours, and so need not give their mite. As far as it can be done, his services will be made available to all, and equally distributed over the whole land ; and, after all, science is not a thing done in a corner. The owner of arable lands may no doubt benefit most ; but one must have read the admirable lectures of Professor Johnston of Durham to little purpose, if he has taken up an idea that pastures cannot benefit largely also. In upland districts, as Mr M'Lean found, artificial manures act most beneficially in such a season as the last. We would not allude to the possibility of there being any persons capable of taking an indolent advantage of other's subscriptions to withhold their own. This would be "left-handed wisdom," indeed ; and all that shall be said of it is, that if such a principle were generally acted on, there would of course be none to support the scheme, and it would fall to the ground. *Let all, then, give freely, and what they like, to the Association, and they should do so quickly, lest opportunities should pass unimproved which are not likely very soon to recur.* If the Subscriptions fall short, or are not promised for a few years certain, what Chemist will care to engage in the service ? or how is the scheme to prosper ?

